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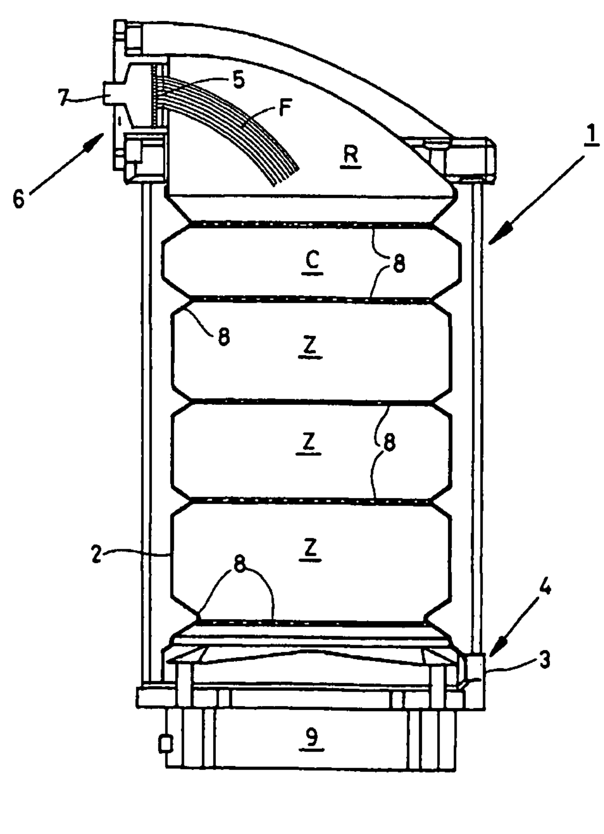
(54) **Title:** SELF CONTAINED WATER FILTER HAVING ZEOLITES, FILTRATION MEMBRANES AND WATER FLOW RATE CONTROL MEANS




**(57) Abstract:** A water filter (1) is described, comprising a water processor vessel (2) filled with filter constituents, such as for example a zeolite blend (Z), activated carbon (C) and filtration elements (F), whereby said vessel (2) has a water input (3) near its lower side (4) and a water output (5) near its upper side (6) for providing an upstream water flow through said vessel (2). The water filter (2) comprises flow rate control means (7) for controlling the upstream water flow through said vessel (2) at such a rate that a wanted low degree of full spectrum contamination of processed output water is achieved in order to fulfil the World Health Organisation standards. If the stand alone water filter (1) is equipped with in particular several types of micro and ultra filtration membrane fibres contaminant concentration in the treated water is extremely low.

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SELF CONTAINED WATER FILTER HAVING ZEOLITES, FILTRATION MEMBRANES AND WATER FLOW RATE CONTROL MEANS

The present invention relates to a water filter comprising a water processor vessel filled with filter constituents, such as for example a zeolite blend, activated carbon and filtration elements.

The present invention also relates to a water treatment system and a water processor vessel suited for application in the water filter or system.

Such a water filter included in a large scale water treatment system is known from WO 96/20139. The known system comprises a pre-treatment unit having one or more sorption filters with replaceable cartridges; a primary treatment unit having a modified zeolite bed, a cation exchanger bed, and an activated carbon bed, a part of which is in bactericidal/silver form ; and a finishing treatment unit having cartridges with micro-filtration elements. All units are coupled through a tubing system wherein shutters are included. The known water treatment system is an elaborate and advanced system involved in the scientific research related to the treatment of water containing toxic contaminants, including heavy metals, organo-phosphorus and organo-chlorine contaminants and pathogenic micro-organisms.

The known system is however not suited to provide an small scale yet advanced water processing filter capable of being applied with means operating to reduce the degree of organism contamination, in particular infections originating from micro organisms, such as bacteria, viruses, proteins and the like.

Therefore it is an object of the present invention to provide an elaborate stand-alone water filter also suited for private households and small communities, which filter is capable of meeting the world health standards for drinking water.

Thereto the water filter according to the invention is characterised in that the vessel has a water input near its lower side and a water output near its upper side for providing an upstream water flow through said vessel; and that the water filter comprises flow rate control means for controlling the upstream water flow through said vessel at such a rate that a wanted low degree of full spectrum contamination in processed output water is achieved.

It is an advantage of the water filter according to the invention that the upstream water flow through the vessel or barrel and the filter constituents in particular zeolite(s) blend, carbon and filtration element(s) included therein, promote an effective and evenly spread movement of water to be processed across the area of the constituents, against the forces of gravity and upwards through the vessel. This results in an improved multistage filter action and output water quality, because the water to be processed is prevented from falling through the filter, like in a downstream gravity filter, which falling through usually occurs in a concentrated, polluted and thus earlier exhausted centre part of the filter constituents.

In addition the time during which the water to be treated resides in the water processing vessel and remains in contact with the filter constituents is advantageously prolonged in such an upstream operating water filter, such

that a sufficiently long contamination exchange contact between the water and the filter constituents is guaranteed.

With the flow rate control means not only a stand-alone and autonomously operating water filter is realised, but with said flow control means usually connected near the water filter or possibly integrated therein, the minimum time can be defined during which the water to be treated by the water filter stays in contamination exchange contact with the filter constituents. This thus guarantees a minimum quality of water treated by the water filter according to the invention. That is why the water filter according to the invention is capable of meeting very high standards, such as the World Health Organisation standards for drinking/drinkable water.

An embodiment of the water filter according to the invention is characterised in that the flow rate control means are coupled to the upper side of the water processor vessel.
Surprisingly it has been found by the inventors that the preferred position of the flow rate control means is close to the top of the water processor vessel, that is coupled to the upper side of the water processor vessel. This way given a sufficient input upstream water pressure an actually wanted water output of the water filter is never capable of emptying the water filter. Consequently the water filter according to the invention is of a type whereof the filter constituents are kept submerged. Consequently the above mentioned high standards can be met during a long period of time, because due to the fact that the filter constituents are under water a drying out or an infection thereof emanating from outside the filter, in

particular due to bacteria, viruses and insects present in outside air is at least prevented, if not impossible.

A further embodiment of the water filter according to the invention is characterised in that the flow rate of the control means is controlled such that only a water output pressure which exceeds a minimum output water pressure threshold enables the water filter to output filtered water.
Advantageously the minimum output water threshold, which may be as low as 1 meter water column (= 0.1 bar), acts as a safety margin in order to always secure that the filter constituents are constantly submerged. In addition the vessel is kept under a constant over pressure, which keeps external contaminants outside the water filter, because these are not capable of entering the water filter else then through the input water which is being filtered and where from the contaminants are removed.

A still further embodiment of the water filter according to the invention is characterised in that the water filter comprises means arranged for promoting a uniform upstream water flow through the water processor vessel.
It is an advantage of the water filter according to the invention that the uniform water flow means promote an equally spread effective use and expenditure of the water filter constituents. This also leads to a more constant quality of water provided by the filter, which quality now is independent from the particular position at which the water passes through the area of the filter constituent stages.

In another embodiment the water filter according to the invention is characterised in that said uniform water flow

means are flow diverting means. These flow diverting means may be embodied as any known flow diverting means capable of promoting a wanted uniform water flow across the area of the vessel and over the height of the filter constituents included therein.

In a particularly simple though effective embodiment of the invention the flow diverting means are embodied as water flow area restrictions, which may be embodied by one or more narrowings of the inner area of the inside wall of the vessel. This has the advantage of preventing water in the vessel from escaping virtually unprocessed along the inside wall of the vessel such that the water will now evenly spread be properly processed by the filter constituents.

A preferred cost price optimised embodiment of the water filter according to the invention is characterised in that the expected water flow rate of the control means is related to the volume of the zeolite blend of the vessel. In practise it is preferred that the ratio between the expected average water flow rate in litres per minute and the volume in litres of the zeolite blend is 0.15 at the most.

In a further preferred embodiment of the water filter the volume of the zeolite blend in the water processor vessel lies between 3 and 30 litres, and in particular lies around 9 litres. In the latter case a housing of the water filter may have an external volume of approximately 80 litres making it particularly suited for application in private households, whereby in small communities larger or several water filters connected parallel may be more convenient.

In order to be able to replace and/or exchange the filter

constituents after lapse of time or after the processing of a sufficient water volume the water filter according to the invention may be characterised further in that the zeolite blend and/or the activated carbon are/is included in one or more cartridges, which are releasable from the vessel. The cartridges or cassettes may then handy be sold separately while filled with newly manufactured or at least partly regenerated, re-activated or refurbished zeolite blend. This way the water filter is capable of treating 20 m3 water in for example approximately 6 month time, before the 9 litre zeolite cartridge has to be change in order to maintain a high quality of the processed water.

A variety of types of zeolites, zeolite combinations or zeolite additive combinations may be used as a blend in the water processor vessel or the cartridges. Examples of possible zeolites are: clinoptilolite, bentonite, phillipsite, chabasite, erionite, heulandite, mordenite, analsite, natrolite, montmorillonite and/or edingtonite. Advantageously additives may be added to the zeolite or the zeolite combinations, such as zand, caviar agricole, calcium, chloride or the like.

The effectiveness of the contamination reduction capabilities of the zeolite applied in the water filter according to the invention may be improved further by treating, possibly pre-treating or renewed treating the zeolite with a sodium containing solution at certain temperature, PH and during a specific treatment time. The effect hereof is that the zeolite becomes enriched with additional sodium atoms, which in turn are capable of being exchanged with atoms of the contaminants, including micro-organisms, heavy metals and organic or inorganic compounds.

Further it is preferred that the water filter according to the invention comprises an carbon cartridge placed on top of the zeolite cartridge, in order to have bad odours, such as originating from organic compounds or the zeolites, withdrawn from the water processed by the zeolite. Furthermore the activated carbon increases the PH of the output water, which makes the processed water softer. In addition it removes pesticides and herbicides from the water.

It is further preferred in an embodiment of the water filter according to the invention that at least a part of the activated carbon, is impregnated with silver, which is known for its an anti-bacterial effect.

A still further preferred embodiment of the water filter according to the invention is characterised in that the filtration elements are membrane filters, including micro membranes and/or ultra membrane. Advantageously the micro membranes are capable of removing macro particles such as from the sediments in the input water, but also micro particles such as bacteria and cists, for example crypto-sporidium, giardia cysts and the like. In addition the ultra membranes are capable of removing colloidal silica, and even viruses from the water. A further advantage of the bringing into action of micro- and/or ultra membrane filtration is that this reduces the dependency of the output water quality on the actual water flow rate controlled by the flow rate control means. In practise these membranes may be devised such that they define an upper boundary concerning the maximum possible output water flow rate given the actual content, amount and size of the water filter concerned. Apart from membranes which are usually flat, the filtration elements may also be

embodied by filtration fibres, which may be formed into strands.

A possible practical embodiment of the water filter according to the invention is characterised in that the water filter comprises a sedimentation chamber at the bottom of the water filter. Advantageously any residue present in the input water may sediment on the bottom of said chamber before entering the upstream path through the water processor vessel. This reduces the chances to an early clogging of the open structure of the zeolites.

In order to reduce a possibly remaining infection from living organisms or micro organisms a water treatment system according to the invention comprising such a water filter is characterised in that it comprises an ultra violet filter for radiating at least part of the water output by the water filter. An example of such an ultra violet filter is also known as "solar" filter UV. With such a solar filter micro and/or ultra filtration may even be omitted from the water filter, if desired.

At present the water filter, the water treatment system, the water processor vessel suited for application in the water filter, all according to the invention will be elucidated further together with their additional advantages, while reference is being made to the appended drawing, wherein similar components are being referred to by means of the same reference numerals. In the drawing:

Fig. 1 shows an perspective outline of the main parts of a preferred embodiment of the water filter according to the present invention;

Fig. 2 shows a schematic line view of the water filter according to fig. 1; and

Fig. 3 shows a schematic view of a water treatment system according to the invention comprising a water filter of figs. 1 and 2.

The water filter 1 as shown in figs. 1 and 2 comprises a water processor vessel 2 filled with filter constituents, generally but not necessary including a zeolite blend Z, activated carbon C and/or filtration elements F. The vessel 2 has a water input 3 at or near its lower side 4 and a water output 5 at or near its upper side 6, arranged such that an upstream water flow is achieved through the vessel 2. The zeolite blend Z may comprise one or more of the following types of zeolites: clinoptilolite, phillipsite, chabasite, erionite, heulandite, mordenite, analsite, natrolite, montmorillonite, edingtonite. Still further types of zeolites Z or more general zeolite blends possibly also containing additives, such as zand, and/or caviar agricole as disclosed in NL 1014497 may be applied, depending on the particular type or types of micro organisms, heavy metals, organic and/or inorganic compounds forming contaminants which have to be removed from the water flowing upstream through the vessel 2. The zeolites may be natural and/or synthetic, should have a constant quality, and should be pure and sufficiently hard in order not to pulverise to easy. The particular zeolite blend Z chosen is normally effective for removing those contaminants which are present at the side where the water filter 1 is positioned. This may in particular but not exclusively be in private households and/or small communities. Non limiting examples of micro organisms effectively removed by the filter constituents are: E-coli bacteria, faecal streptococci, legionella bacteria, cysts and several kinds of viruses. As heavy metals are in particular mentioned here: zinc, copper, lead, cadmium,

iron etcetera. Inorganic compounds mentioned are: ammonium and chloride; and some organic compounds are pesticides, herbicides, aromatic compounds (PACs) and the like. Activated carbon C is also effective against at least these organic compounds. If impregnated such as with with silver the activated carbon is known to have an additional antibacterial effect. The zeolite blend Z and/or the activated carbon C are/is preferably included in one or more cartridges (not explicitly shown), which are together with the filtration elements F stacked, preferably in the order as shown in fig. 2. These cartridges may be releasable from the vessel 2 and may be exchanged easily by fresh or regenerated zeolite blend and/or carbon. The carbon cartridge C will then be placed on top of the zeolite cartridge(s) Z.

The filtration elements F may be filtration membranes which are usually flat or possibly filtration fibres, which may form strands. The filtration membranes in particular comprise micro filtration membranes and/or ultra filtration membranes. These respective filtration membranes are manufactured e.g. by a company named S.Search at Dedemsvaart, The Netherlands. The manufacture and use of these membranes are for example disclosed in WO 00102085, and EP-A-0998972, respectively, whose disclosures are incorporate here by reference thereto. The filtration membranes or fibres F are coupled to flow rate control means 7 to be elucidated hereinafter. The fibres F may have inner channels and an open porous structure such that processed water collected in a collecting room R in the upper part of the filter 1 is allowed to flow through the open outer surface to one or more inner channels and then to these control means 7. Preferably the collecting room R has an internally sloping shape, which is such that it

allows air trapped inside the vessel 2 to be collected in the top of the room R and then driven out with the outgoing water flow, which makes the filter 1 self de-aerating.

In order to control or adjust the rate of the upstream water flow through the vessel 2 the filter or at least a water treatment system 10 wherein the water filter 1 is included comprises flow rate control means 7. In figs. 1 and 2 the flow rate control means 7 are provided at the upper side 6 of the filter 1 and simply formed by a cost effective automatic constant volume regulator 7 in order for it to provide water at a wanted quantity or rate. This regulator may at wish be constructed such that it maintains some overpressure of for example 0.1 bar in the vessel 2, which may be useful to prevent the occurrence of unwanted infections from outside the water filter 1. If wanted a tap may be coupled to the means 7, which may simply be of the open/closed type, because the automatic constant volume regulator 7 will control the outgoing water flow rate anyhow. Advantageously the processed water is always available at the point of use, directly after the processing by the filter 1.

The control means 7 may as far as necessary comprise more complicated microprocessor controlled means, wherein for example a flow sensor provides a water flow rate and/or water pressure dependent signal to the microprocessor, which controls the throughput of an orifice of a controllable valve of said means 7. The control means 7 generally control the upstream water flow through water processor vessel 2 at such a rate that a wanted low degree or concentration of the above mentioned contaminants in the processed and output water is achieved. The means 7 may also be provided at any wanted position upstream or

downstream relative to the filter constituents. A position near the upper side 6 is however preferred because this will keep the filter constituents submerged, thus reducing the changes to an unwanted infection of the inside or content of the water filter 1. Additionally a water meter (not shown) can be added at an appropriate place in the system 10 for reading the amount of water treated by the filter 1. This provides an indication as to the moment whereon one or more of the filter constituents Z, C have to be replaced by new or regenerated constituents.

In order to promote a continuous and uniformly distributed upstream water flow in the vessel 2 measures have to taken' by constructing uniform flow means 8, such as flow diverting or water flow spreading means. These means 8 may for example comprise one or more perforated plates 8 provided at wanted positions along the height and at the inside the vessel 2. A further simple example of flow diverting means 8 in the form of flow area restrictions 8 is also shown in figs. 1 and 2. These restrictions are formed by narrowed parts 8 of the inner area of the vessel inside wall. These consecutive narrowings 8 form respective water path extensions, which divert the water flow away from the inside wall of the vessel 2 back to the zeolite blend, every time such narrowed part 8 is encountered. This way upstream flowing water in the vessel 2 is prevented from channelling, that is escaping unprocessed along the inside wall of the vessel. This leads to a further quality improvement of the processed output water. The walls of the cartridges mentioned earlier are permeable for the input water and given the low upstream water pressure and controlled water rate the residence and contact time of the water in the vessel 2 with the filter constituents will be long, which increases the output water quality.

In order not to waist constituents, in particular zeolites Z the expected water flow rate of the control means 7 is related to the volume of the zeolite blend in the vessel 2. As a preferred practical example the ratio between the expected average output water flow rate in litres per minute and the volume in litres of the zeolite blend (Z) is 0.15 at the most. If for a household application an upper boundary of 180 litre per hour is assumed then 30 litres of zeolite at the most are sufficient. In one embodiment built the water filter 1 carries 9 litres of zeolite in a vessel being 75 cm high and having a diameter of approximately 30 cm. The water flow rate may then be 40 litres per hour, whereby the filter 1 then works at a water pressure of only 0.1 bar.

If the zeolite or zeolite blend Z is pre-treated before inclusion in the water filter 1 or if it is being regenerated after lapse of a useful period in the filter 1 with at least a sodium containing solution, then its micro filtration and ion exchange properties will improve. In this zeolite pre-treatment process critical parameters such as sodium concentration, temperature, treatment time and PH are combined in order to improve the zeolite filter filtration and ion exchange properties by at least a factor two. If these parameters are properly fine tuned then regeneration of the zeolite blend can be carried out at least ten times.

During research it is established that an average water flow rate of approximately 30-50 litre per hour provides optimised results in terms of heavy metal content remaining after treatment, as well as filtration effects established by the sufficiently long interaction of the contaminating

particles in the water to be treated and the zeolites in the vessel 2.

In the upstream operating filter 1 the water flow after entering the water input 3 will be fine filtered with an approximately 75 µm filter (not shown). Particles having this size or a larger size tend to obstruct the open structure of the zeolites, which would degrade a proper filtration operation. Then the water enters a sedimentation chamber 9 and against the force of gravity, it flows through the filter constituents. Sediment particles are being caught by the gravity force and will thus precipitate on the bottom of the upstream operating filter 1 in the sedimentation chamber 9.

A water treatment system 10 such as exemplified in fig. 3 may principally comprises one or more water filters 1 arranged in parallel, if desired. The water filters 1 may also be included in well known piped water distribution networks and systems. In that case it may be necessary to apply a well known water pressure reduction valve. The system 10 as shown comprises gutter means 11 for collecting rain water and a pre-filter 12, which may be a mechanical filter. The pre-filter 12 is arranged for not passing particles having a size in the range from approximately 200 µm and upwards. A filter in the form of a sintered PE (polyethylene) filter has proven to be cost effective and operationally effective. The pre-filtered water is then provided to a storage tank 13 in order for large sediments to sediment therein. In this embodiment the stored water from the tank 13 is fed to the water filter 1. Optionally and/or depending on the filter constituents used in the vessel 2 an ultra violet or solar UV filter 14 may be coupled to the water output 5 for protecting the output

water against infections, parasites and the like by radiating the output water. The filter 14 operates very effective, which is due to the fact that the amount of UV obstructing sediments in the output water is very low.

Table I hereafter provides purification performance test results of treated output water in three types of tests, wherein the above described water filter 1, called RainPC, is used without filtration elements (type STB), with micro membrane filtration (type STM) and with ultra membrane filtration (type STU) respectively. In the table X denotes that the remaining contamination concentrations concerned are in accordance with the World Health Organisation regulations. The test results reveal an extremely good result over the full range of contaminants, but in particular in the field of disease provoking micro organisms.

Whilst the above has been described with reference to essentially preferred embodiments and best possible modes it will be understood that these embodiments are by no means to be construed as limiting examples, because various modifications, features and combination of features falling within the scope of the appended claims are now within reach of the skilled person.

Tabel I

| Contaminants Removed | RainPC STB | RainPC STM | RainPC STU |
|---|---|---|---|
| *Micro-organisms* | | | |
| E-coli, faecal streptocci | 99.9 % | 99.999999 % | 99.999999999 % |
| Cysts | Test pending | 99.999 % | 99.999999 % |
| Legionella | 99.9 % | 99.999999 % | 99.999999999 % |
| Viruses | - | - | 99.9 % |
| *Heavy metals* | | | |
| Zinc | X | X | X |
| Copper | X | X | X |
| Lead | X | X | X |
| Cadmium | X | X | X |
| *Inorganic compounds* | | | |
| Ammonium | X | X | X |
| Chloride | X | X | X |
| *Organic compounds* | | | |
| Pesticids and herbicids | X | X | X |
| Aromatic compounds (PAC) | X | X | X |
| Taste/odour | X | X | X |
| Colour (Pt/Co) < 20 mg/l | X | X | X |
| Sediment (turbidity <4 FTE) | X | X | X |

CLAIMS

1. A water filter (1) comprising a water processor vessel (2) filled with filter constituents, such as for example a zeolite blend (Z), activated carbon (C) and filtration elements (F), characterised in that the vessel (2) has a water input (3) near its lower side (4) and a water output (5) near its upper side (6) for providing an upstream water flow through said vessel (2); and that the water filter (2) comprises flow rate control means (7) for controlling the upstream water flow through said vessel (2) at such a rate that a wanted low degree of full spectrum contamination of processed output water is achieved.

2. The water filter (1) according to claim 1, characterised in that the flow rate control means (7) are coupled to the upper side (6) of the water processor vessel (2).

3. The water filter (1) according to claim 2, characterised in that the flow rate of the control means (7) is controlled such that only a water output pressure which exceeds a minimum output water pressure threshold enables the water filter (1) to output filtered water.

4. The water filter (1) according to one of the claims 1-3, characterised in that the water filter (1) comprises means (8) arranged for promoting a uniform upstream water flow through the water processor vessel (2).

5. The water filter (1) according to claim 4, characterised in that said uniform water flow means (8) are flow diverting means (8).

6. The water filter (1) according to claim 5, characterised in that the flow diverting means (8) are embodied as water flow area restrictions (8).

7. The water filter (1) according to claim 6, characterised in that at least the inner area of the inside wall of the vessel (2) is narrowed.

8. The water filter (1) according to one of the claims 1-7, characterised in that the expected water flow rate of the control means (7) is related to the volume of the zeolite blend (Z) of the vessel (2).

9. The water filter (1) according to claim 8, characterised in that the ratio between the expected average water flow rate in litres per minute and the volume in litres of the zeolite blend (Z) is 0.15 at the most.

10. The water filter (1) according to claim 9, characterised in that the volume of the zeolite blend (Z) in the water processor vessel (2) lies between 3 and 30 litres, and in particular lies around 9 litres.

11. The water filter (1) according to one of the claims 1-10, characterised in that the zeolite blend (Z) and/or the activated carbon (C) are/is included in one or more cartridges (), which are releasable from the vessel (2).

12. The water filter (1) according to claim 11, characterised in that at least one of the cartridges contains a zeolite (Z) comprises clinoptilolite, bentonite, phillipsite, chabasite, erionite, heulandite, mordenite, analsite, natrolite, montmorillonite and/or edingtonite.

13. The water filter (1) according to claim 12, characterised in that the zeolite (Z) is pre-treated with a sodium containing solution at certain temperature, PH and during a specific treatment time.

14. The water filter (1) according to one of the claims 11-13, characterised in that the water filter (1) comprises a carbon cartridge (C) placed on top of the zeolite cartridge (Z).

15. The water filter (1) according to one of the claims 1-14, characterised in that at least a part of the activated carbon (C) is impregnated with silver.

16. The water filter (1) according to one of the claims 1-15, characterised in that the filtration elements (F) are membrane filters, including micro membrane and/or ultra membrane fibres.

17. The water filter (1) according to one of the claims 1-16, characterised in that the water filter (1) comprises a sedimentation chamber (9) at the bottom of the water filter (1).

18. A water treatment system (10) comprising a water filter (1) according to one of the claims 1-17, characterised in that the water treatment system (10) comprises an ultra violet filter (14) for radiating at least part of the water output by the water filter (1).

19. A water processor vessel (2) suited for application in a water filter (1) according to one of the claims 1-17, said vessel (2) is at least filled with a

zeolite blend (Z), activated carbon (C) and filtration elements (F), characterised in that the vessel (2) has a water input (3) at its lower side (4) and a water output (5) at its upper side (6) for providing an upstream water flow through said vessel (2); and that said vessel (2) comprises flow rate control means (7) for controlling the upstream water flow through said vessel (2) at such a rate that a wanted low degree of full spectrum contamination of processed output water is achieved.

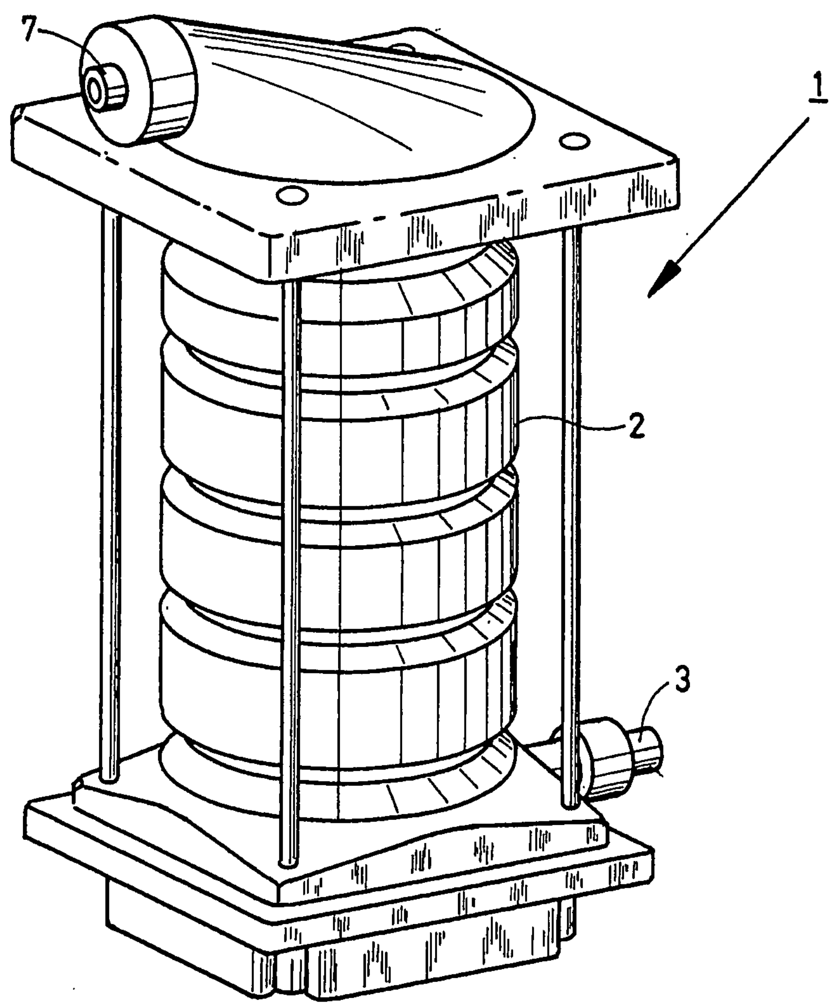


FIG.1

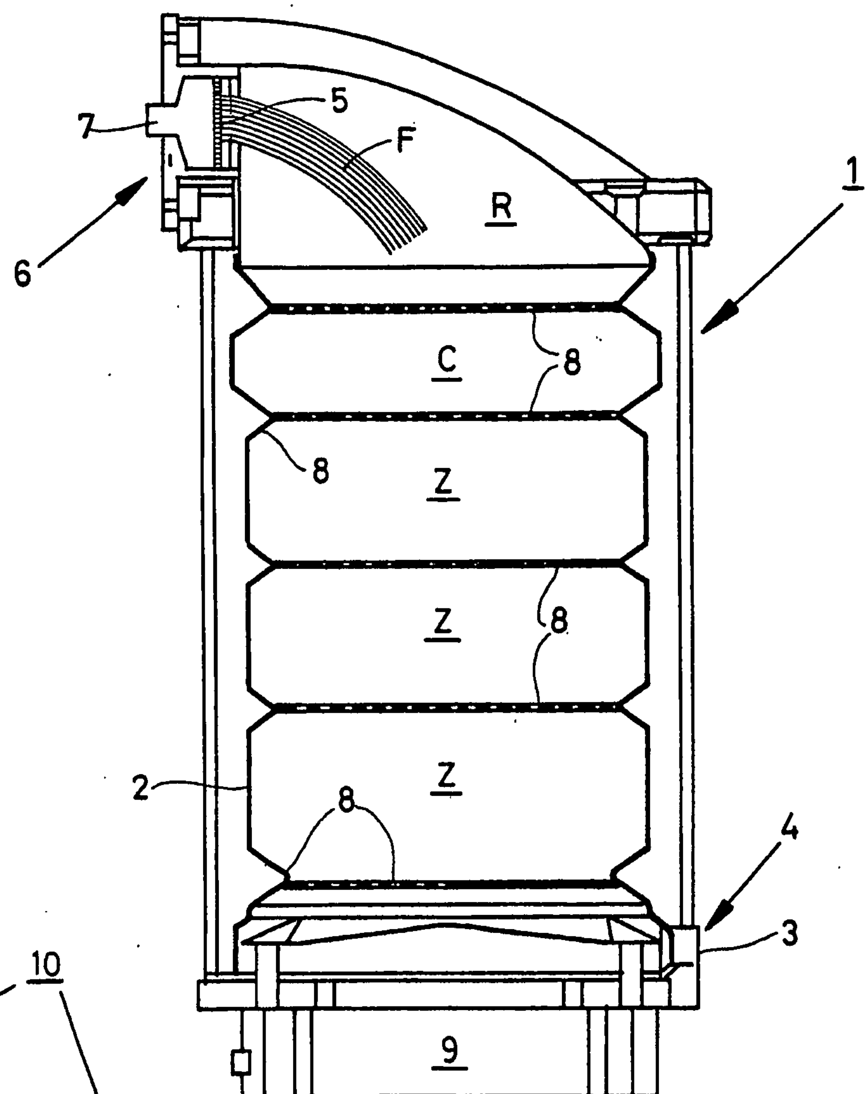


FIG. 2

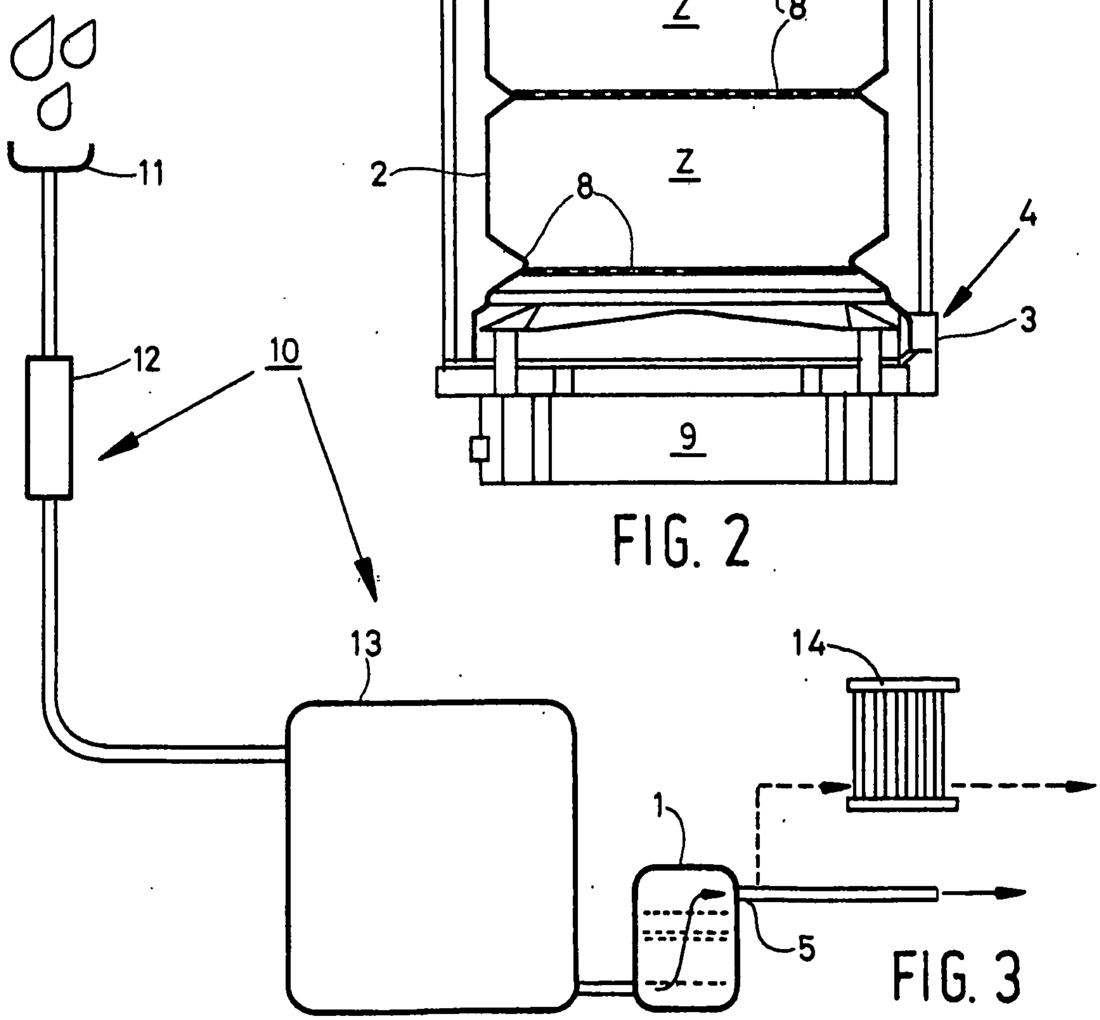


FIG. 3

# INTERNATIONAL SEARCH REPORT

ıtional Application No
PCT/NL 01/00665

**A. CLASSIFICATION OF SUBJECT MATTER**
IPC 7 C02F1/00 B01D37/04

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 C02F B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | DE 29 17 134 A (BAENSCH TETRA WERKE) 30 October 1980 (1980-10-30) the whole document --- | 1,12 |
| A | US 3 823 824 A (CLOSE S) 16 July 1974 (1974-07-16) figures 5,6 --- | 1,12 |
| A | PATENT ABSTRACTS OF JAPAN vol. 008, no. 134 (C-230), 21 June 1984 (1984-06-21) & JP 59 046185 A (MARUCHIYUU BOUEKI KK), 15 March 1984 (1984-03-15) abstract --- | 1,12 |
| A | FR 2 780 718 A (CYTHELIA) 7 January 2000 (2000-01-07) page 6, line 46-48 --- | 1,12 |

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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| European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016 | Devisme, F |

## INTERNATIONAL SEARCH REPORT

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PCT/NL 01/00665

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication,where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | DATABASE WPI<br>Derwent Publications Ltd., London, GB;<br>AN 1989-071542<br>XP002198229<br>& JP 01 022393 A (KYIRITSU HOUSEHEEL KK),<br>25 January 1989 (1989-01-25)<br>abstract<br>--- | 1,12 |
| A | PATENT ABSTRACTS OF JAPAN<br>vol. 017, no. 638 (C-1133),<br>26 November 1993 (1993-11-26)<br>& JP 05 200386 A (NGK INSULATORS LTD),<br>10 August 1993 (1993-08-10)<br>abstract<br>--- | 1,12 |
| A | US 6 120 686 A (BILZ ROLAND)<br>19 September 2000 (2000-09-19)<br>the whole document<br>--- | |
| A | EP 0 668 243 A (AWECO KUNSTSTOFFTECH<br>GERAETE) 23 August 1995 (1995-08-23)<br>the whole document<br>--- | |
| A | US 5 643 444 A (GARRIGUES PATRICK ET AL)<br>1 July 1997 (1997-07-01)<br>the whole document<br>--- | |
| A | DE 44 22 709 A (SHECO AG)<br>4 January 1996 (1996-01-04)<br>the whole document<br>----- | |

INTERNATIONAL SEARCH REPORT

ıtional Application No
PCI/NL 01/00665

| Patent document cited in search report | | Publication date | Patent family member(s) | | | Publication date |
|---|---|---|---|---|---|---|
| DE 2917134 | A | 30-10-1980 | DE | 2917134 | A1 | 30-10-1980 |
| US 3823824 | A | 16-07-1974 | NONE | | | |
| JP 59046185 | A | 15-03-1984 | NONE | | | |
| FR 2780718 | A | 07-01-2000 | FR | 2780718 | A1 | 07-01-2000 |
| JP 1022393 | A | 25-01-1989 | NONE | | | |
| JP 05200386 | A | 10-08-1993 | JP | 3217831 | B2 | 15-10-2001 |
| US 6120686 | A | 19-09-2000 | DE | 19610172 | A1 | 18-09-1997 |
| | | | AU | 2632197 | A | 10-10-1997 |
| | | | CA | 2249341 | A1 | 25-09-1997 |
| | | | WO | 9734832 | A1 | 25-09-1997 |
| | | | EP | 0888247 | A1 | 07-01-1999 |
| EP 0668243 | A | 23-08-1995 | DE | 4401691 | A1 | 27-07-1995 |
| | | | DE | 59509597 | D1 | 25-10-2001 |
| | | | EP | 0668243 | A2 | 23-08-1995 |
| US 5643444 | A | 01-07-1997 | FR | 2714847 | A1 | 13-07-1995 |
| | | | EP | 0662453 | A1 | 12-07-1995 |
| DE 4422709 | A | 04-01-1996 | DE | 4422709 | A1 | 04-01-1996 |